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coldest of northern regions life is never totally absent, and may be found when carefully searched for. But, it must be conceded, life becomes "living," so to say, only during a very short period, a rapid summer, during which the temperature rises above zero. The study of marine cold-blooded organisms, in the northern climes, furnishes, I think, the extreme limit of cold under which organisms can live and reproduce themselves. Fr. Kjellmann, during his wintering in Mosselbay (Spitzbergen) some twenty years ago, observed a number of algæ at the coldest period of the year, and was satisfied, by direct observation, that they did most decidedly give issue to the sexual elements, and that the process of reproduction was in full activity while the temperature of the water was permanently below zero, between  $-1^{\circ}$  and  $-3^{\circ}$  (salt water having a lower freezing point than fresh, about  $3^{\circ}$ ). I do not know of instances of organisms thriving individually and specifically at lower temperatures, of organisms doing the same, while their internal temperature cannot be above that of the environment. Lichens must certainly be considered as living at much lower temperatures, since they perform the breathing function at  $-10^{\circ}$ ,  $-20^{\circ}$  and at much lower aerial temperatures, but do they reproduce themselves under such conditions? Experiments are wanting, and till they have been performed, we may consider that the *lowest internal temperatures* at which organisms may *thrive and reproduce*, is  $-2^{\circ}$  or  $-3^{\circ}$ , and that some algæ do live under these conditions in the northern seas amidst the blocks of ice (Kjellmann: *Vegetation hivernale du Algues a Mosselbay, Spitzberg, apres les observations faites pendant l'expedition polaire suedoise en 1872-1873: Comptes Rendus de l'Academie des Sciences*, 1875).

As to extreme heat, I find no instance more satisfactory than that of Van Tieghem. In a paper, *Sur des bacteriennes vivant a la temperature de  $74^{\circ}$  Centigrades* (published in the *Bulletin de la Societe Botanique de France*, 1881, Vol. 28), he has given the results of his experiments on certain bacteria, and has found that one species is able to thrive and to reproduce itself at  $74^{\circ}$ , while at  $77^{\circ}$  it dies. Many other micro-organisms can bear for some time  $60^{\circ}$  or  $70^{\circ}$  C., but I know of no other able to live permanently at  $74^{\circ}$  and to give posterity under such conditions. No doubt a large number of observers, of whom I have given some names, with the results they have obtained, in a paper: *Les temperatures extremes compatibles avec la vie*, (*Revue Scientifique*, 27 May, 1893), have given instances of plants and animals living in hot springs, and, if some were to be believed, animals and plants would have been found in boiling water. I do not say the thing is impossible, but great care must be taken when ascertaining the temperature of thermal waters. Hoffe Seyler has shown that under the uppermost layer of water, which may be very warm, colder layers are to be found, and animals may seem to live in heated water, when in fact they live in normal conditions. Unless special care is taken to observe the temperature at the very level where living organisms are found, we can take no serious account of the numerous and startling observations made by a number of travellers, and abstracted by Goeffert, formerly, and recently by H. Weed (*9th Ann. Rep. of U. S. Geol. Survey by Powell*, p. 619). There is no reason to suppose that no organisms can live and reproduce themselves at an internal temperature of more than  $74^{\circ}$ . Such organisms do doubtless exist, but we cannot feel assured of the fact yet. Persons who investigate thermal springs should be very careful in their measurements; correct observations can be of great use for the present question, although, in point of fact, I much prefer a good experiment, such as that of Van Tieghem's. But nothing prevents the completion of the observation by experiment.

## BOOK-REVIEWS.

*Abnormal Man: Being Essays on Education and Crime and Related Subjects.* By ARTHUR MACDONALD. Washington: Government.

THIS is a goodly pamphlet of more than four hundred pages issued by the Bureau of Education, of which the author is an officer. It is of a somewhat desultory character, consisting mainly, as the author says in his preface, "of essays and of digests of foreign literature which have already appeared in different periodicals." These various articles, however, have been changed, more or less, and much new matter has been added. The object of the book is to inquire into the causes of crime with a view to their removal, and especially to consider the influence of education in repressing crime. It opens with a brief notice of the various classes of abnormal men, whom the author divides into four classes: the dependent class, including the inmates of almshouses, hospitals, orphan asylums, etc.; the delinquent class, or criminals; the defective class, such as the insane, imbecile, deaf and dumb and others; and finally, men of genius or great talent. The ranking of men of genius with the other classes mentioned is itself a rather abnormal proceeding, and the chapter in which the author endeavors to show that genius is nearly allied to insanity is likely to meet with little favor. His remarks on that subject, however, are aside from the main purpose of the book, which is to treat of the criminal class and the methods of eliminating or repressing it.

At the outset Mr. MacDonald raises the question whether and in what way the elementary education that has now become so general throughout the civilized world affects the increase or decrease of crime; and after presenting many tables of statistics on the subject, comes to the conclusion, which the reader is likely to share, that "the exact relation between education and crime is unknown." He remarks, however, that "it would be difficult to find a criminal who in a single instance could attribute the cause of his crime to education;" and adds that "perhaps as good a test as any is for one to ask himself if the teaching of ordinary branches in his school days gave rise to immoral or criminal desires." But if school education does not increase crime, there is not much evidence that it tends to diminish crime; and thus we are brought to the subject of moral education as distinguished from the intellectual sort, which is the chief product of the schools. Mr. MacDonald justly remarks that "while the moral and intellectual sides of education necessarily exist together, yet society is most solicitous about the former; for an individual may be a good citizen with little instruction if he has sound morality, but the reverse is not true." This, however, immediately raises the perplexing question, which is as old as Socrates, and which moralists of all ages have tried to answer, whether virtue can be taught, and, if so, by what means; but though our author realizes the importance of the problem, we cannot see that he contributes anything new to the solution of it.

The relation of education to crime, however, is only one of the topics discussed in this book, which deals with the whole subject of criminology with special attention to the question of preventing crime. In pursuing this theme the author says little directly about remedies, but confines himself mainly to the study of causes, on the ground that "all the conditions, occasions and causes of crime must be investigated first, if the treatment is to be a rational one." After pointing out the special topics for inquiry in criminology, he proceeds to set forth the views that have been advanced by leading writers on the subject in recent years, with special reference to the theories of the Italian school, which inclines to regard crime as a mental

disease. Mr. MacDonald's own views are expressed with caution, and in many cases he confines himself to expounding the ideas of the author he is dealing with, without offering any opinion of his own. The question of alcoholism in its relation to crime is treated at considerable length, and the views of many different writers presented; but, as is usually the case in discussions of that subject, the variety of opinions prevailing and the lack of sufficient information about the actual physical effects of alcohol result in leaving the question unsettled.

Mr. MacDonald's book contains much that will be useful both to those who are beginning the study of criminology and to the original investigator. To the former it will suggest the most important topics for investigation and the proper methods of work, while to the latter it will serve as a guide to the literature of the subject in all its departments. In this last-named respect the book is especially strong, since it gives not only a great many digests of recent works, but also an extended bibliography of the whole subject, filling more than two hundred pages. On the whole, though we do not agree with all the author's views, we have found his book on many points both interesting and suggestive.

#### LETTERS TO THE EDITOR.

\*.\*Correspondents are requested to be as brief as possible. The writer's name is in all cases required as a proof of good faith.

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

#### ANIMAL VOCABULARIES.

CERTAINLY one who believes in evolution cannot deny the existence of a language, of some sort, which enables the lower animals to communicate in a more or less intelligent degree.

Even my five-year-old little girl feels assured of the fact that animals can talk, "but not in our words." Only yesterday I sent her to the barn with an armful of fresh corn husks for our pony. She came running back with beaming countenance, exclaiming: "Daisy was so glad, she wanted to kiss me."

Several years ago I took great interest in some fine Brahma chickens we had raised from fluffy little chicks. There was one fine old grandmother hen which we bought to start with. She came recommended as a "good mother." And a good mother she proved to be, but she had her way of training a family. She went at it in earnest. She clucked and scratched and pointed out the best things to eat. She was fully impressed with the fact that she had a duty to perform, and she had the courage to devote herself entirely to this duty. But she always insisted upon early independence. She did not approve of chicks clinging to her and depending upon her when they were able to "scratch" for themselves, and hence she made it a rule to "wean" them early. She always gave them a parting lecture. She looked very wise and solemn, and "ca-cawed" in a peculiar tone, while the chicks stood about her in a sort of dazed, sorrowful way, wondering, no doubt, what would become of them. One "talk" ended the matter. She went off to roost alone, and the deserted chicks huddled together, "vaguely thinking" what a cold world.

Another interesting characteristic about this old grandmother hen was her solicitude for young hens who were just beginning to experience the first inclinations to sit. She would stand before their nests, and "talk" in the most earnest, subdued tones; her vocabulary must have been quite extensive, for she could continue without any hesitation for such a long time. It always seemed to me

that she was relating her own experience and giving advice to the young and inexperienced of her kind. Certainly the young hens appeared to listen with all the respect possible—they no doubt "thought" that she magnified the cares and responsibilities; at least she never dissuaded a young hen from her resolution to sit. I agree with the writer in the last issue of *Science* (No. 549), who says "there is no need of going beyond the barn yard to hear a definite animal vocabulary of a considerable number of words."

If our language is the result of evolution, it has come up through lower forms, and it is only legitimate to credit animals with a varying degree of power of communicability.

MRS. W. A. KELLERMAN.

#### THE CIRCULATION IN FRESH-WATER MUSSELS.

IN order to demonstrate the course of the circulation in a fresh-water mussel the student is commonly directed to make six injections: from the ventricle forward into the systemic arteries; backward through the auricles into the efferent branchial vessels; from the vena cava forward into the organ of Bojanus, and backward into the system; and into one of the branchial sinuses forward into the gills and backward into the organ of Bojanus.

I have, however, sometimes succeeded in demonstrating several of these connections by a single injection as follows: Cut away a small portion only of the outer lamina of the outer gill, make a little opening into the branchial sinus and with a very slow, steady pressure inject into it. The course of the injection may then be easily watched as it proceeds down the inner lamina of the gill, and after a little time begins to ascend in the outer lamina. Presently it will begin to escape at the cut ends of the efferent branchial vessels; enough of these are, however, left intact, so that most of the fluid passes on up to the auricle, thence into the ventricle, and it may be followed as it sets out from the heart towards the front and rear of the body on its systemic journey. At the same time, of course, the injection will flow from the starting point back into the efferent vessels of the organ of Bojanus.

I have not succeeded in continuing the pressure long enough or steadily enough to make the fluid pass on into the vena cava; the small systematic vessels seem to offer so much resistance that the injection is pretty sure to make a break somewhere before it finally succeeds in making its way through them; and in the same way the renal vessels fail to transmit it backwards into the vena cava. It is very likely that a steadier hand than mine might succeed better, or that an injection controlled by the force of gravity might be made to demonstrate the complete and orderly circuit of the blood around to the starting point; but even the injection of two-thirds of the entire circuit and the gradual progress of the fluid from point to point is instructive.

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#### PROTECTIVE MIMICRY OF A MOTH.

A CORRESPONDENT of "*Science*," August 4, notes a case of protective mimicry of a moth. From the brief description given, the insect may be the Red Humped Apple-tree Caterpillar Moth, *Oedemasia concinna* which has just been reared from larvæ, at the University of Kansas, where work is being done in an economic and biologic collection of insects. About a dozen caterpillars were received from Delphos, Kansas, July 19, and after preserving two or three in alcohol, the remainder were put in breeding cages with apple leaves for food. By July 13, all had pupated, some going into ground at surface, while the majority made thin cocoons among the twigs and leaves in such manner as to be completely enveloped and hidden. Adults emerged by August 14, and then it was noticed how easily